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AIRS Validation Plan

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AIRS Algorithm and Validation Plan Objective

REQUIREMENT: “1 K / 1 km” measurements.

In the first year, on-orbit activation, first calibration, and early validation will be aimed at establishing the AIRS ability to meet this requirement.

T(p) - 1 K rms in 1 km layers below 100 mbar
q(p) - 20 % rms in 2 km layers below 200 mbar
Surface temperature - 1 K

1999 EOS Reference Handbook

AIRS Products and Algorithms

- 1 K / 1 km -

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AIRS Level 2 Products

Air temperature

Lower tropospheric humidity

Upper tropospheric humidity

Ozone

Sea surface temperature

Land surface temperature

Cloud properties

Precipitation

AIRS Level 1 Products

Microwave radiances

Infrared radiances

Vis/NIR radiances

AIRS Algorithms

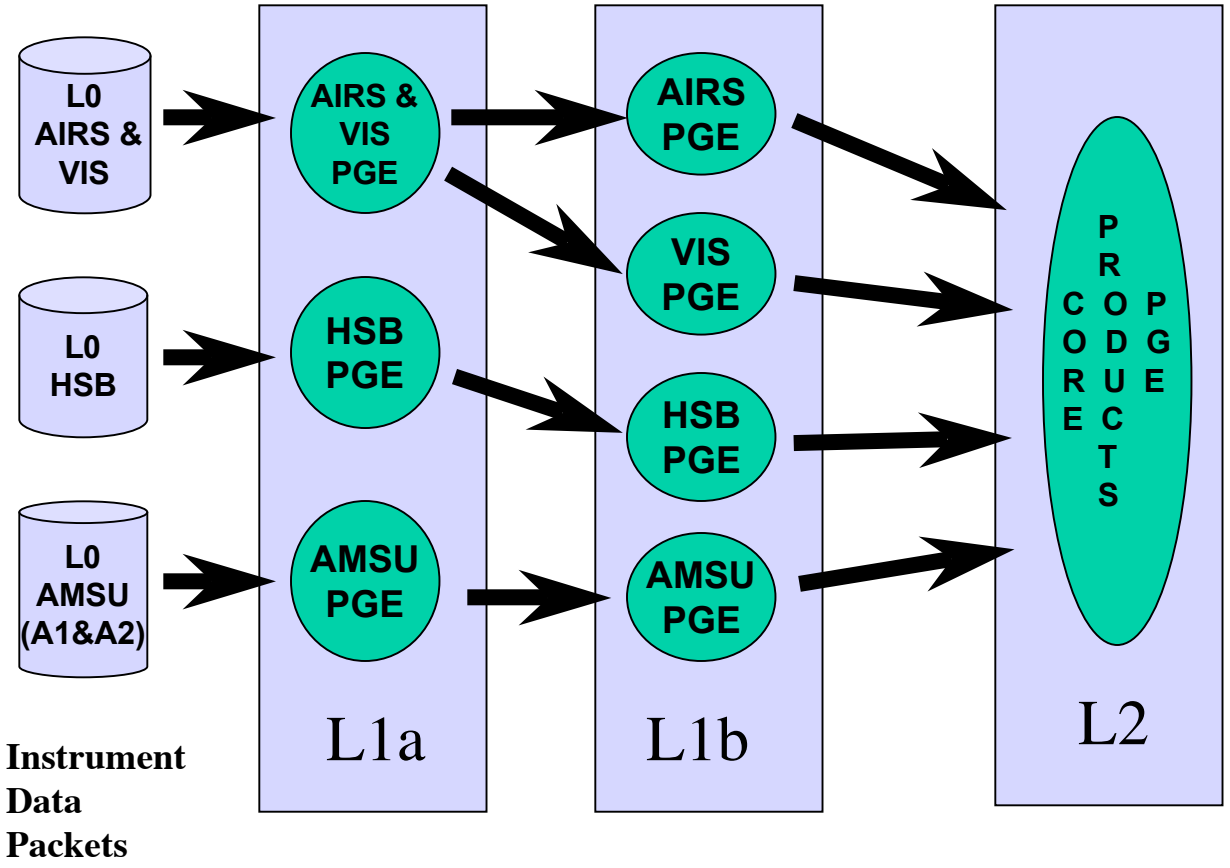
Forward model

Cloud clearing

Calibration

Priorities for the first year
Direct path to validation
Indirect validation

AIRS Product Generation System



Not shown: Browse and Tuning PGEs

AIRS/AMSU/HSB Products

- The PGS generates several product files
  - Calibrated radiances from each L1b PGE
  - 4 files from the L2 PGE of retrieved quantities (products) at the AMSU footprint resolution
    - Standard
      - T, q, O_3, surface and cloud properties
      - 30 layers for profiled quantities
    - Support
      - All retrieved quantities (including research products)
      - 100 layers for profiled quantities
    - Cloud Cleared Radiances (size dictates separate file)
    - QA Support
      - Only created for software problem debugging

(See EOS Reference Handbook 1999 & AIRS Science and Measurement Requirements, 1991 for added confusion……)

AIRS/AMSU/HSB Products

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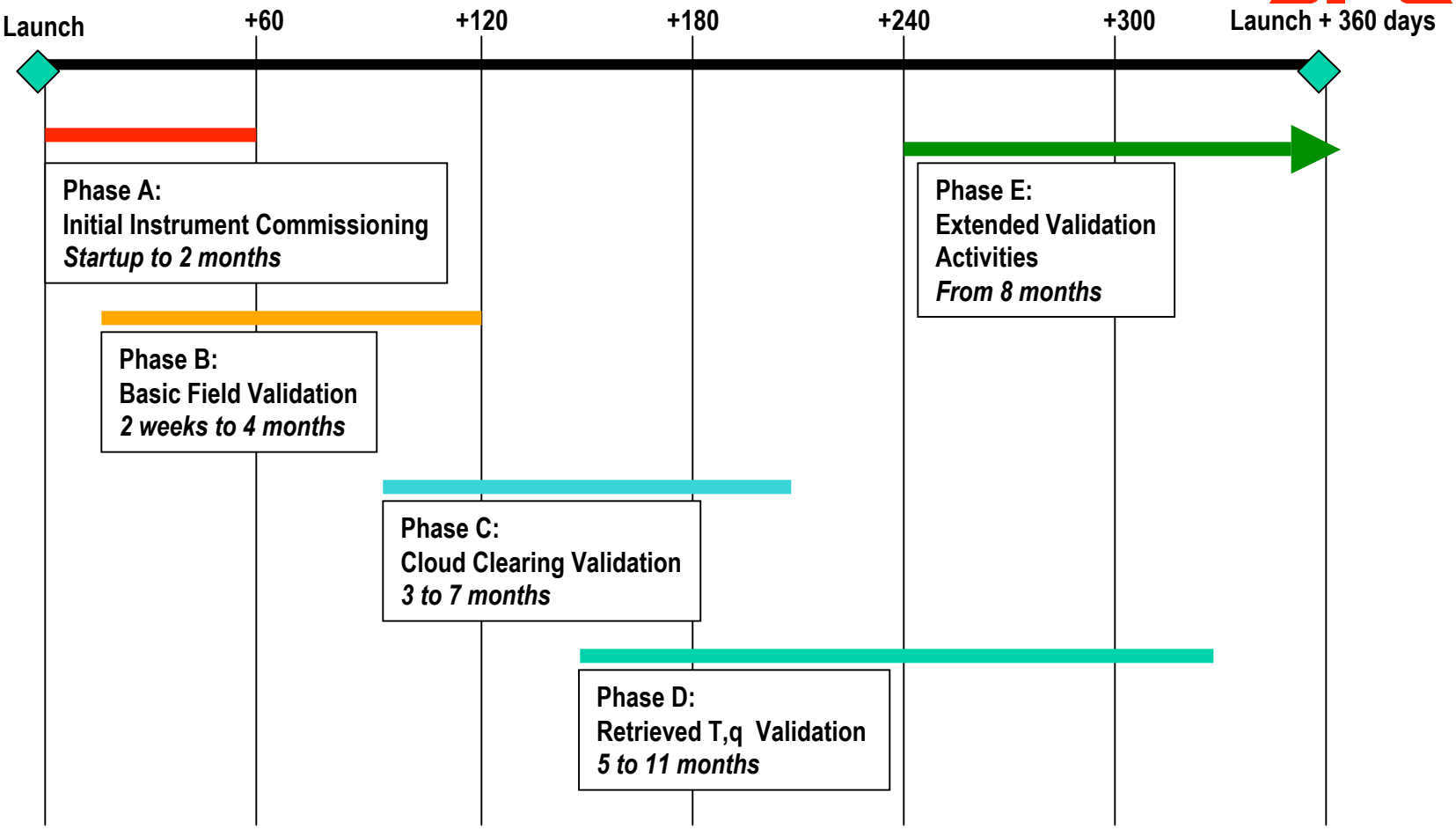
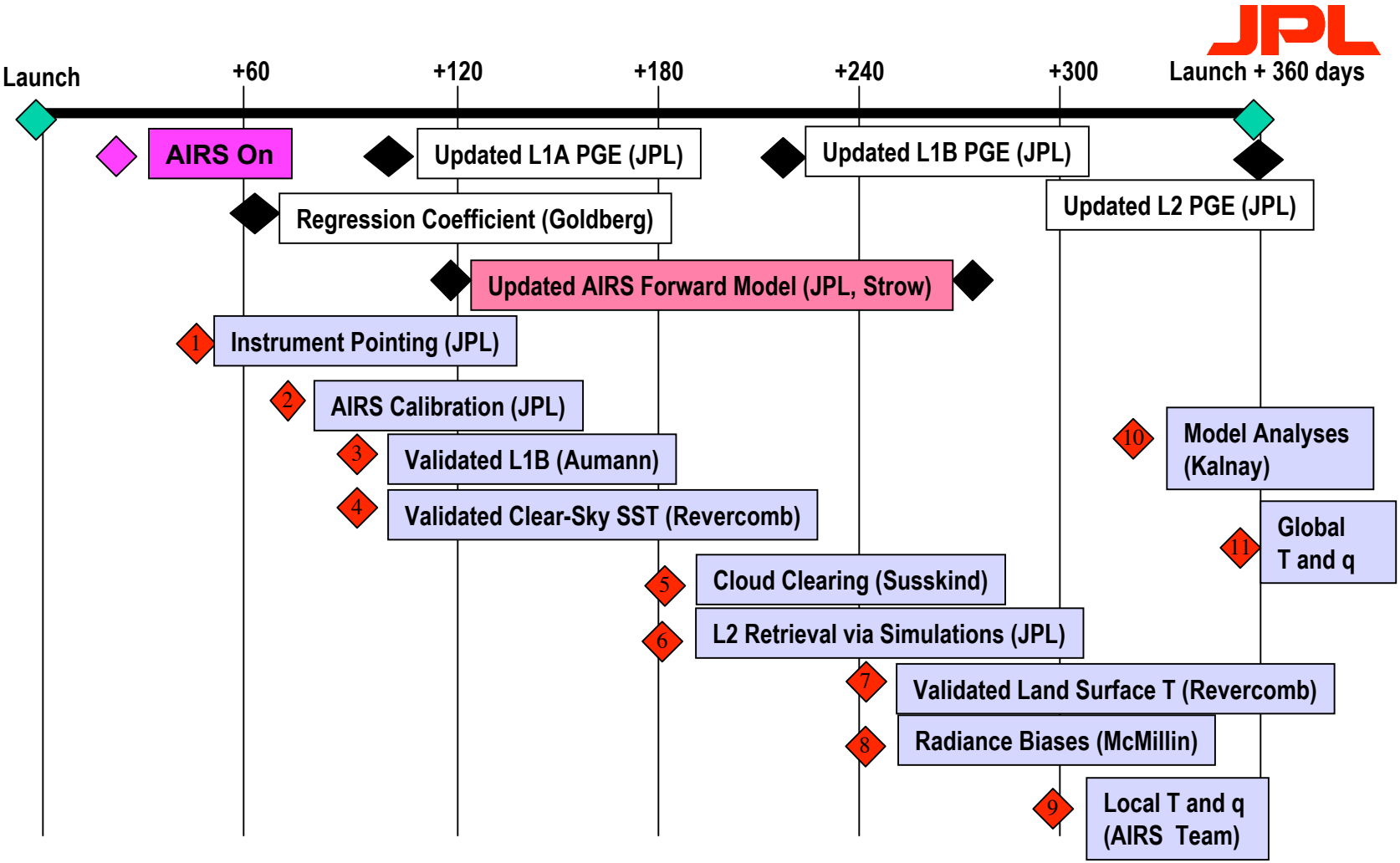
- The AIRS requirements were published in the 1991 brochure 'AIRS Science and Measurement Requirements'
  - Available online at AIRS DocuShare at http://airs-lib/
  - These requirements have since been modified slightly (current values are in the AIRS Validation Plan).

AIRS Early Validation Timeline

Characterizing the atmospheric column and surface observed by AIRS/AMSU/HSB

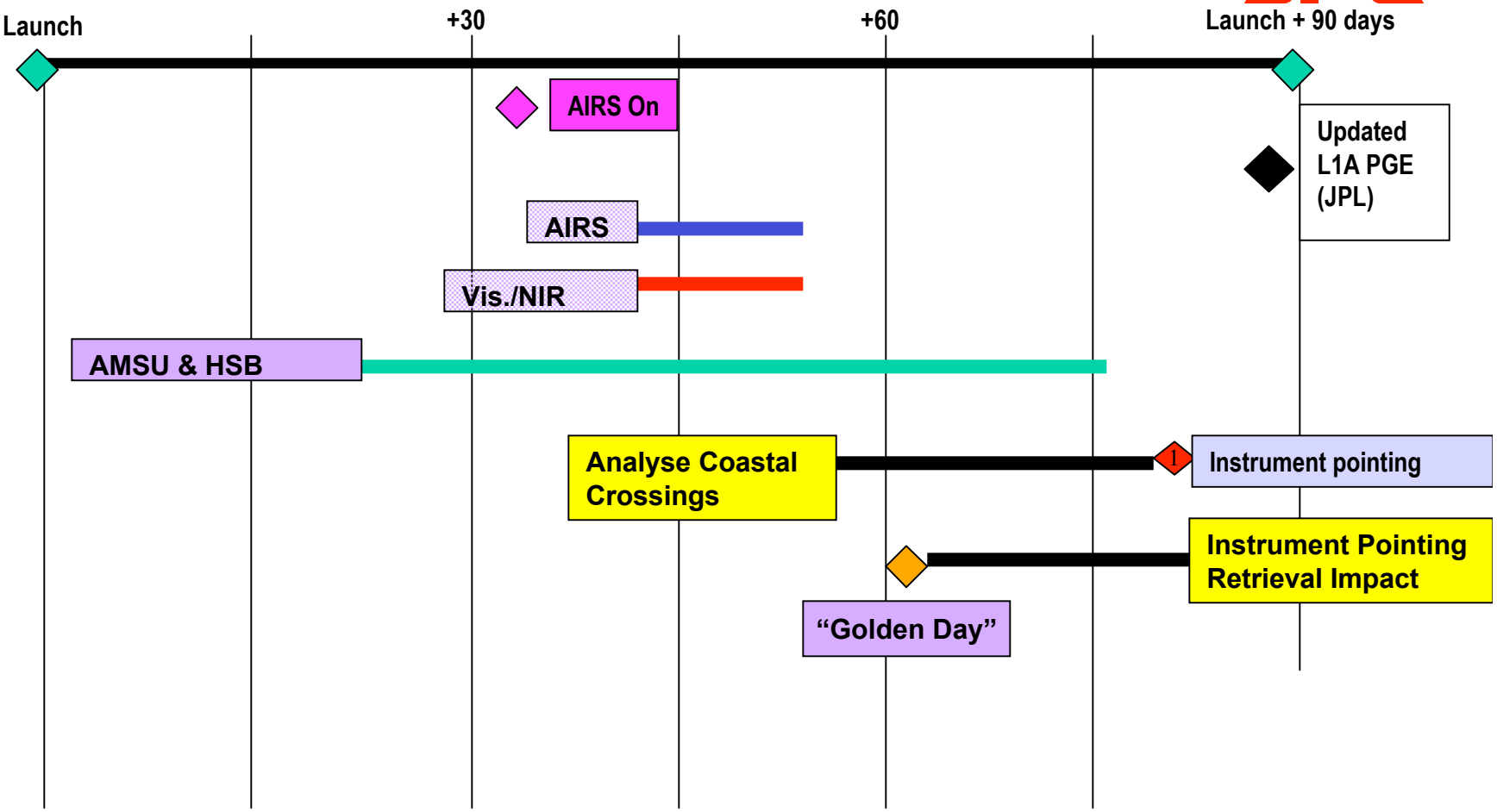


AIRS/AMSU/HSB
Validation Schedule and PGE Deliveries



Instrument Pointing and Co-alignment

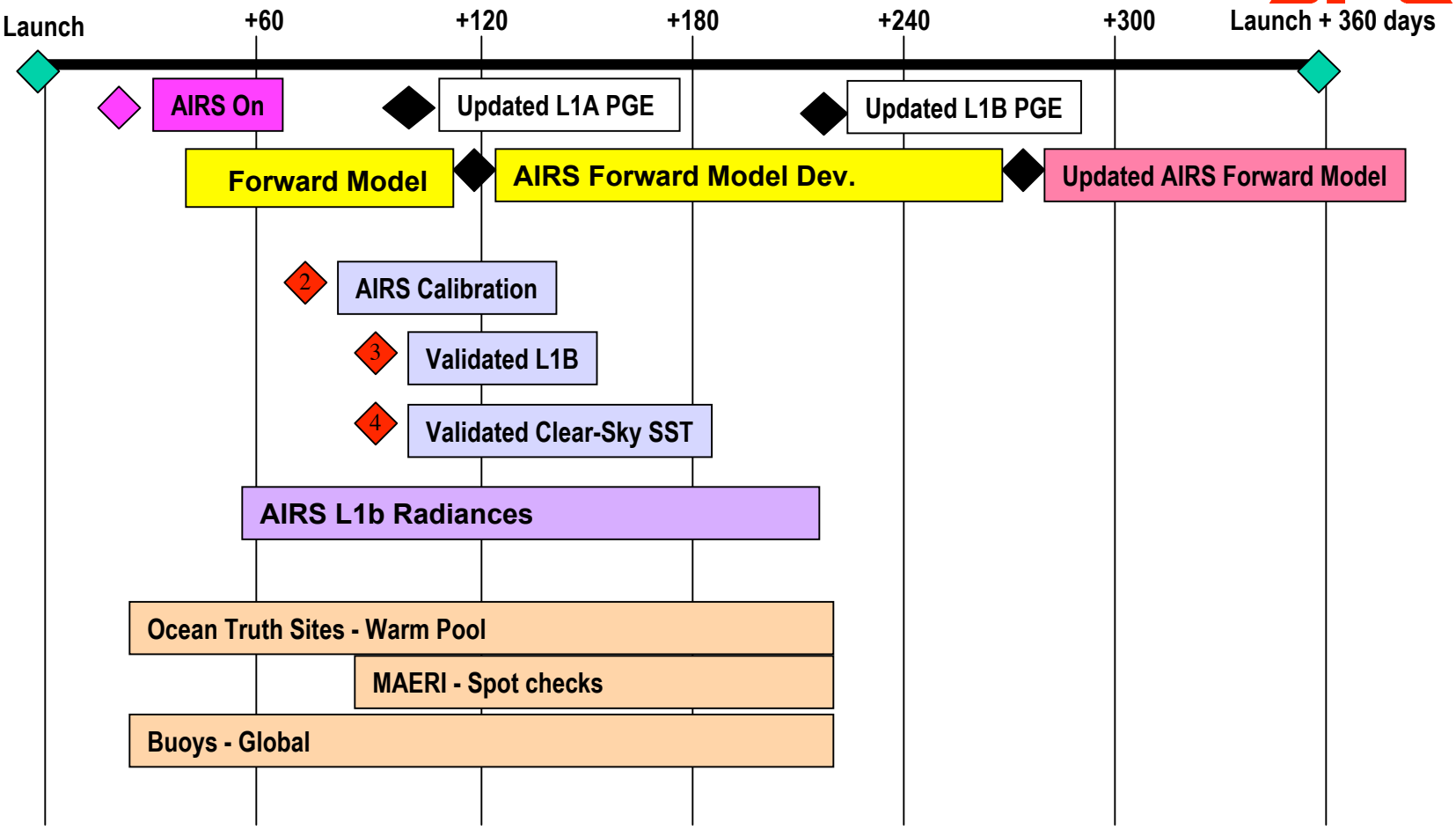
Responsibilities: Lambrigtsen, Gregoritch, Hofstadter



Note bene the expanded time-scale

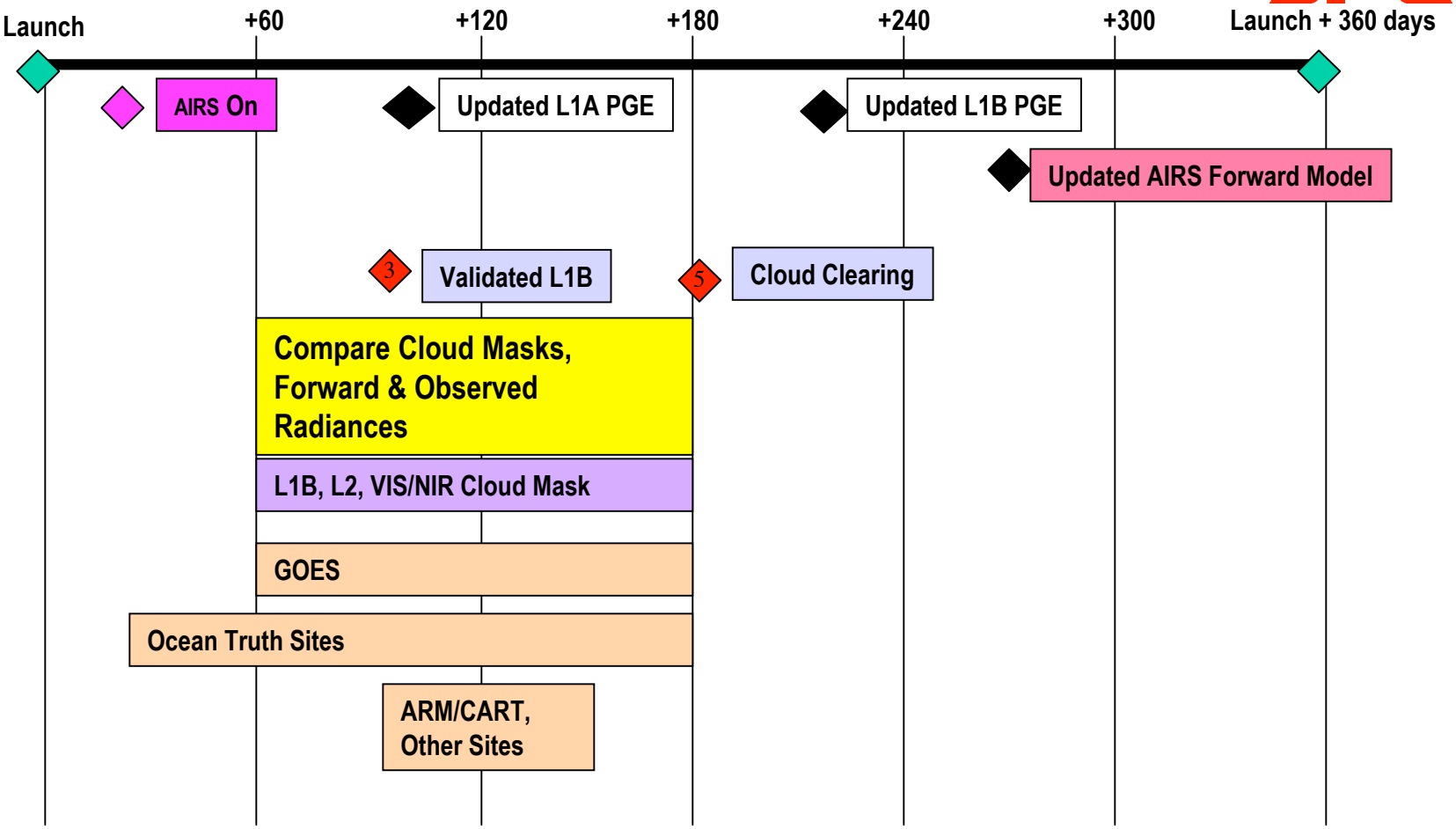
AIRS Calibration, and L1B - SST Validation

Responsibilities: Aumann, Strow



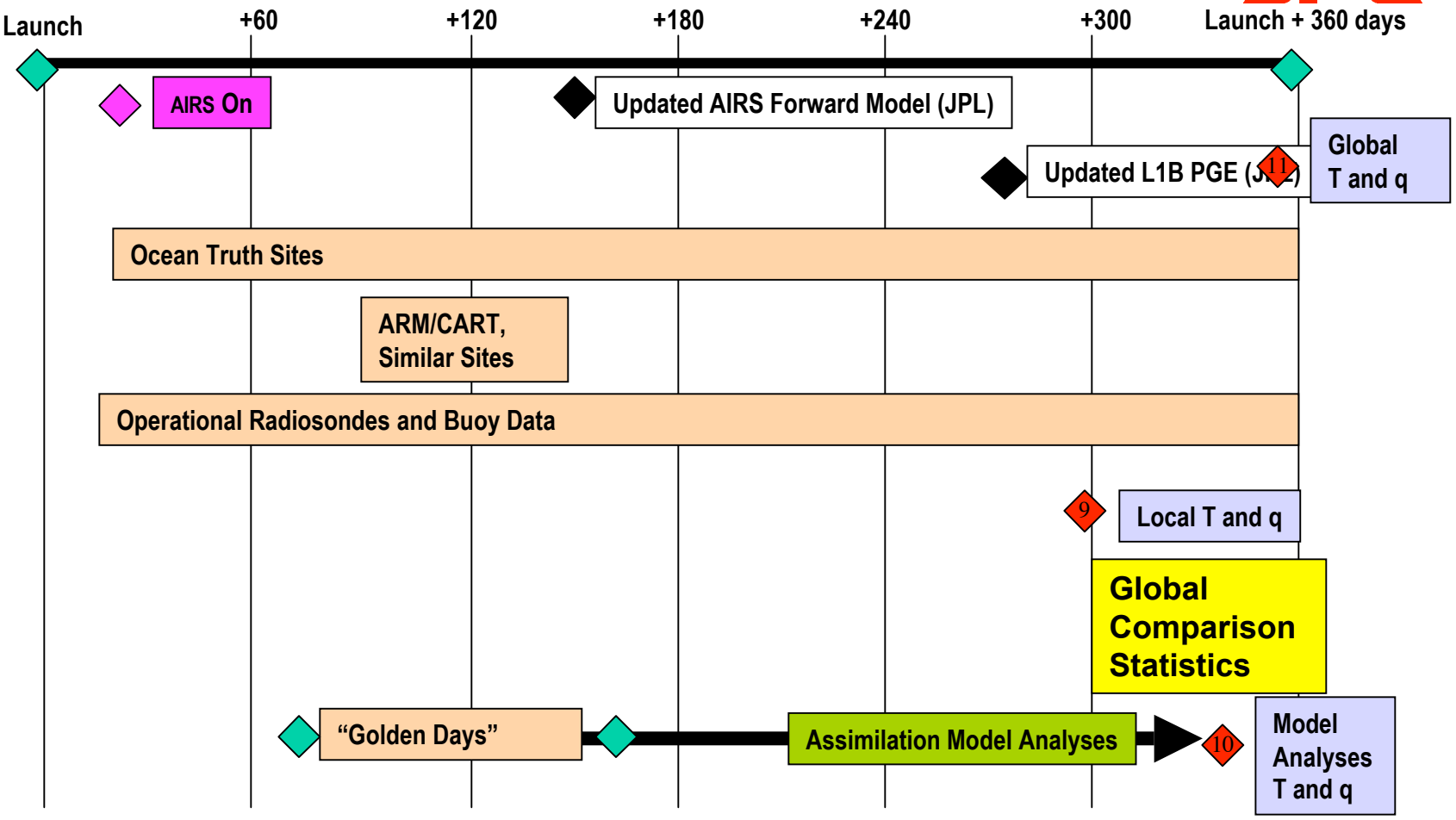
Cloud-Cleared Radiance

Responsibilities: Susskind, Gunson



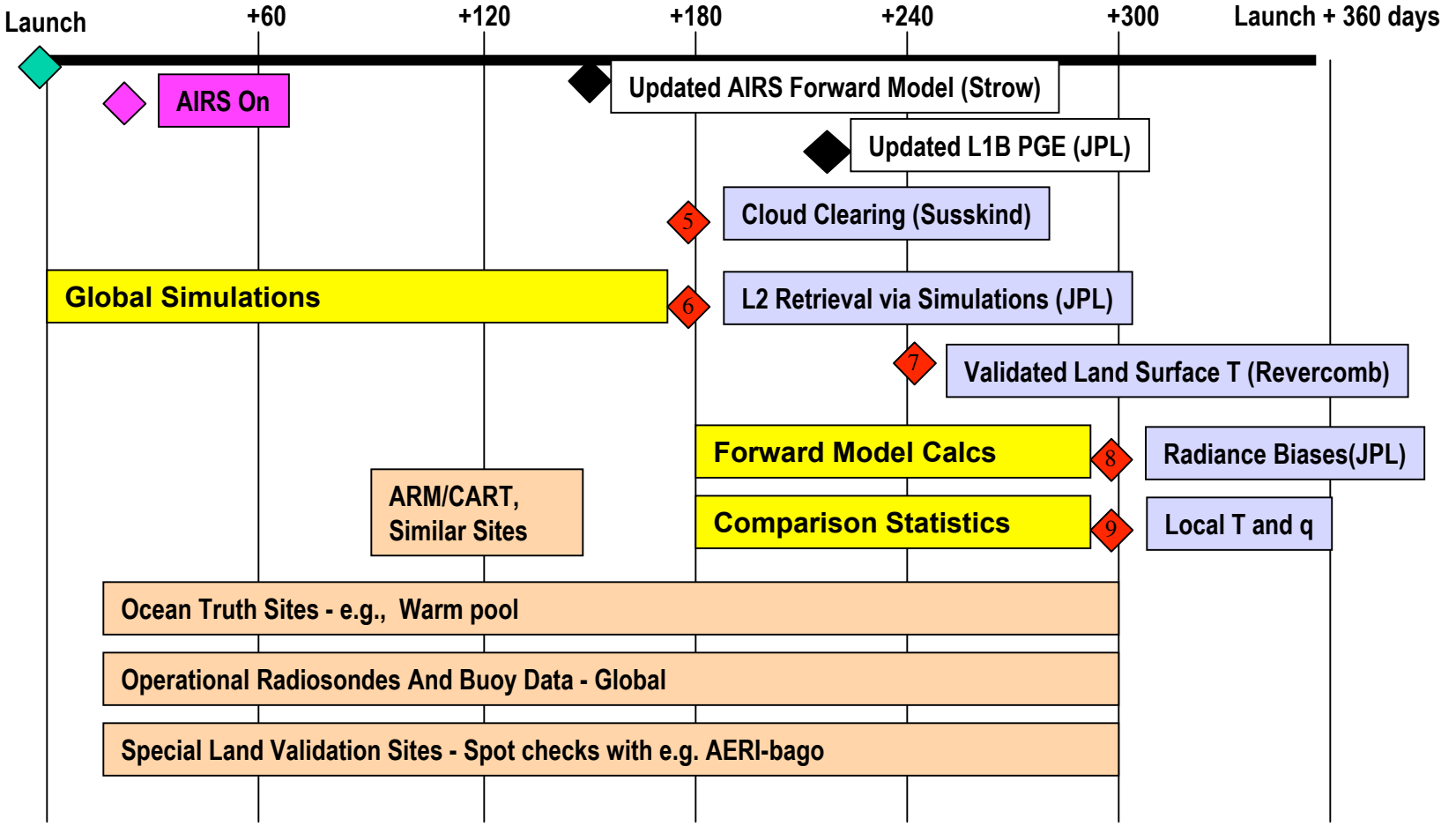
Global T and q -- 1 K/1 km and 20% Humidity

Responsibilities: Chahine, AIRS Team



Accuracy of Local T and q

Responsibilities: Gunson, Susskind



Validation of T and q at local sites

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- Prerequisite to global validation of T and q, to establish accuracy at ground truth sites
- RMS errors for different conditions at Truth sites (3 ARM-CART sites, 2 European, 1 Australian, 2 Brazilian):
  1) Clear sky over ocean sites
  2) Cloudy sky over ocean sites
  3) Clear sky over mid-latitude land sites
  4) Cloudy sky over mid-latitude land sites
  5) Polar site conditions
- RMS of these is the uncertainty under limited conditions
- Extend to a global analysis with radiosondes and other truth data

Requirements for Local Validation of T and q

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- Validated Level 1B radiances (Aumann)
  - Following Calibration, preliminary SST validation under clear skies
- Validated SST, LST retrieval (JPL, Revercomb)
  - Hierarchy from clear SST to cloudy LST
- Level 2 algorithm verified by global simulations
- Cloud-cleared radiance validation (JPL, Susskind)
- A statistically significant set of correlative observations for each local truth site (Revercomb)
  - Many hundreds of total observations are needed for statistical significance for the five climate conditions of interest
- Land surface emissivity/temperature (Smith)

Deliverables for Local Validation of T and q

- Atmospheric state at ARM-CART sites (Revercomb):
  - Derived from comprehensive observations of surface, temperature and humidity
  - Accuracy and utility assessed by forward model calculations
- Collocate these with AIRS observations (JPL).
  - Comparison of AIRS retrieved and ARM-CART derived state for radiance biases
  - Statistics of differences in retrieved state
- Update L2 retrieval (Susskind)
- Accuracy of AIRS RTA assessed by detailed comparison of calculated and observed clear sky and cloud-cleared radiance spectra (Strow).
- Extend analyses from local ARM-CART sites to global radiosonde profiles (McMillin)

Aqua Instrument Intercomparisons

Cloud Properties	**AMSR-E cloud liquid water** **MODIS cloud mask, cloud top temperature and altitude** **CERES cloud mask, cloud top temperature**
Radiance Energy Fluxes	**CERES flux** **MODIS surface flux**
Precipitation	**AMSR-E rainfall rate**
Atmospheric Temperature	**MODIS temperature profiles**
Atmospheric Humidity	**AMSR-E total water vapor** **MODIS total water vapor and profiles**
Land Surface Temperature	**AMSR-E LST** **MODIS LST**
Sea Surface Temperature	**AMSR-E SST** **MODIS SST**

Commitments obtained from AIRS Team

Requirements

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- To support the Science Team validation activities, we will
  - Zeroth order check on all data within 24 hours to ensure important fields are filled and filled within reasonable bounds, and check QA flags set in processing -> don't waste *your* time with stupid bugs
  - Match-up truth with observed data (if necessary) and verify
    - Identify granules over ground truth sites -> archive at JPL
    - Create truth-rich granules of data for reprocessing
  - Identify granules for testing, e.g. clear sky over ocean
  - Evaluate "bronze" footprints at L1b with simple forward model
  - Accumulate statistics on comparisons with truth data
  - Later, identify representative problem granules (e.g. sun glint?, Tibetan plateau, polar cases)
  - Accumulate radiance bias and rms statistics for comparison cases
  - Verify and assess QA flags and parameters

More TLSCF and JPL Responsibilities

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- TDS data production, archiving, and cataloguing service
  - Provide on-line or archive all relevant AIRS data provided from the DAAC (the “10%” and the “golden” days or orbits)
  - Provide on-line access and archive of all relevant validation data to Science Team
- Deliver PGS upgrades to DAAC
- Geolocation and boresight validation
- AIRS calibration and validation of L1b radiances
- Vis/NIR calibration and validation
- Validate “1 K/1 km” AIRS capability against ground truth data
- Coordinate and validate global “1 K/1 km” AIRS capability by model analyses and data assimilation

AIRS Science Team Member Responsibilities

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- **H. H. Aumann** (JPL): AIRS instrument verification of on-board calibration and Level 1b radiometric validity during Phase A Instrument Checkout. Sea surface properties including temperature during Phase B and C. Correlation with MODIS surface IR in phase D.

- **M. T. Chahine** (JPL): Verification of vis/nir measurements in Phase A, Infrared Cloud Properties, VIS/IR cloud properties correlation in phase B, C, D. Correlation with MODIS cloud properties in phase D.

- **C. Gautier** (UCSB): Verification of vis/nir calibration in Phase A. Validation of clear sky conditions from vis/nir measurements in Phase B. Validation of VIS cloud properties starting in Phase C. Correlation with MODIS Land VIS in phase D.

- **M. Goldberg** (NOAA): Global validation of level 1b (EF decomposition) phase B. Validation of the first products in Phase C. Cross-validation with NOAA-15 and –16 phase D.

- **Eugenia Kalnay** (UMCP/NCEP) validation of AIRS level 1b clear data by assimilation of AIRS level 1b into analysis during phase A and B. Assimilation into forecast model in phase C and D.

- **L. McMillin** (NOAA): Validation small angle correction and interpolation in Phase A. Validation of tuning software in phase B. Validation of temperature and moisture profile using global statistics starting in Phase C.

AIRS Science Team Member Responsibilities(2)

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- **H. Revercomb** (UWisc.), level 1b validation phase A and B, ARM-CART site observations and synthesis of atmospheric state from these measurements for intensive spot validation of AIRS products in Phase C. Land surface temperature and emissivity validation in phase D.
- **P. W. Rosenkranz** (MIT): AMSU level 1b validation during Phase A. Microwave-only retrievals of temperature and humidity during Phase B.
- **W.L. Smith** (LARC): Support of surface emissivity product validation using Aircraft (NAST-I)
- **D. Staelin** (LL/MIT): HSB level 1b validation during Phase A. Validation of precipitation in Phase C. Cross-validation of precipitation with NEXRAD data.
- **L. L. Strow** (UMBC): SRF shape validation in Phase A. Forward model validation starting with clear sky radiance measurements in Phase B. Minor gas retrieval software validation in Phase C.
- **J. Susskind** (GSFC): validation of "clear flag" in phase A. Validation of the cloud-clearing algorithm and cloud-cleared radiance product during phase B. Validation of derived IR cloud properties in Phase C. Validation of Final Product quantities and error bars in Phase D.